ConOps Development in a Highly Networked System

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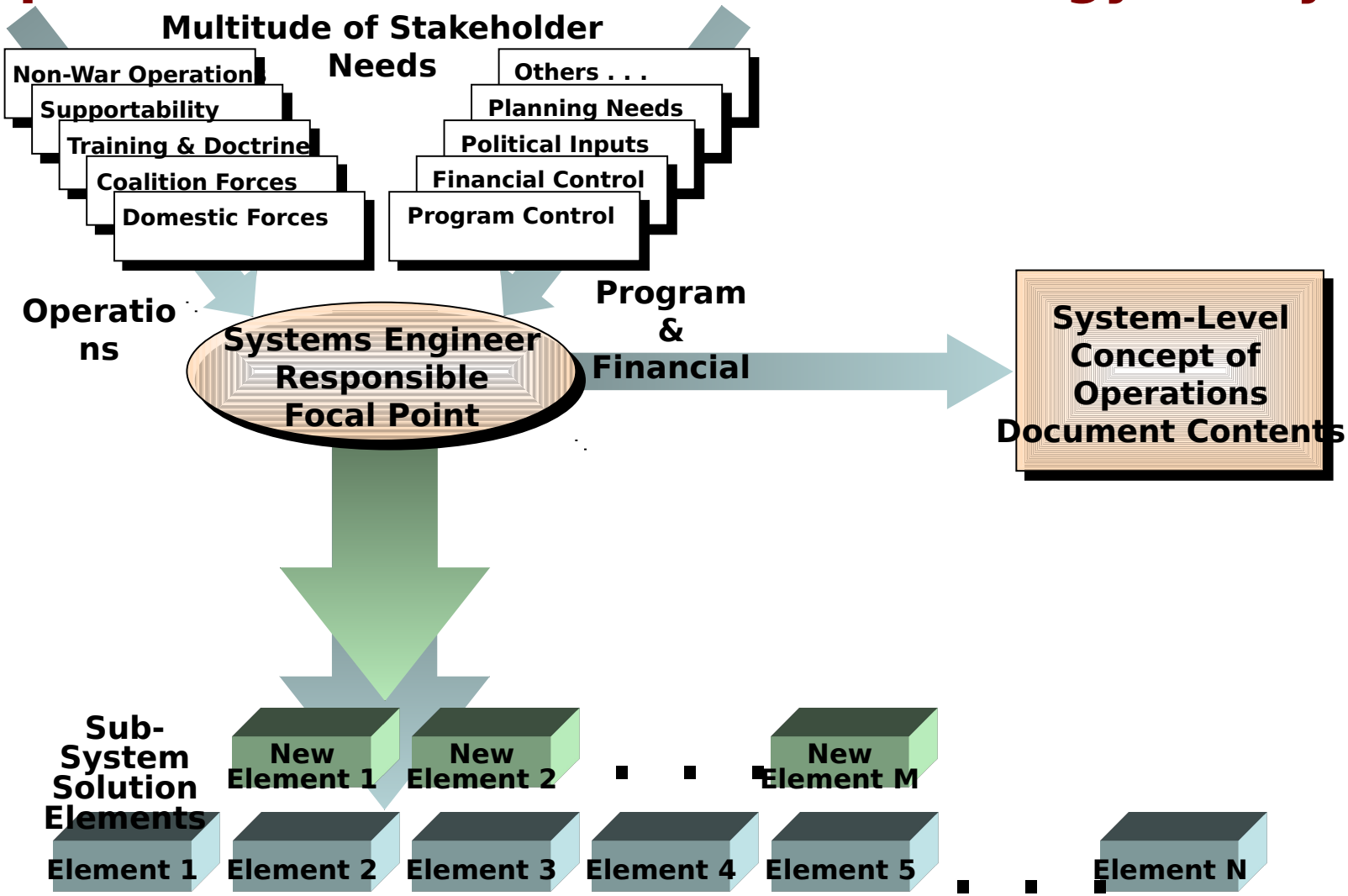
NCS ConOps Development Agenda

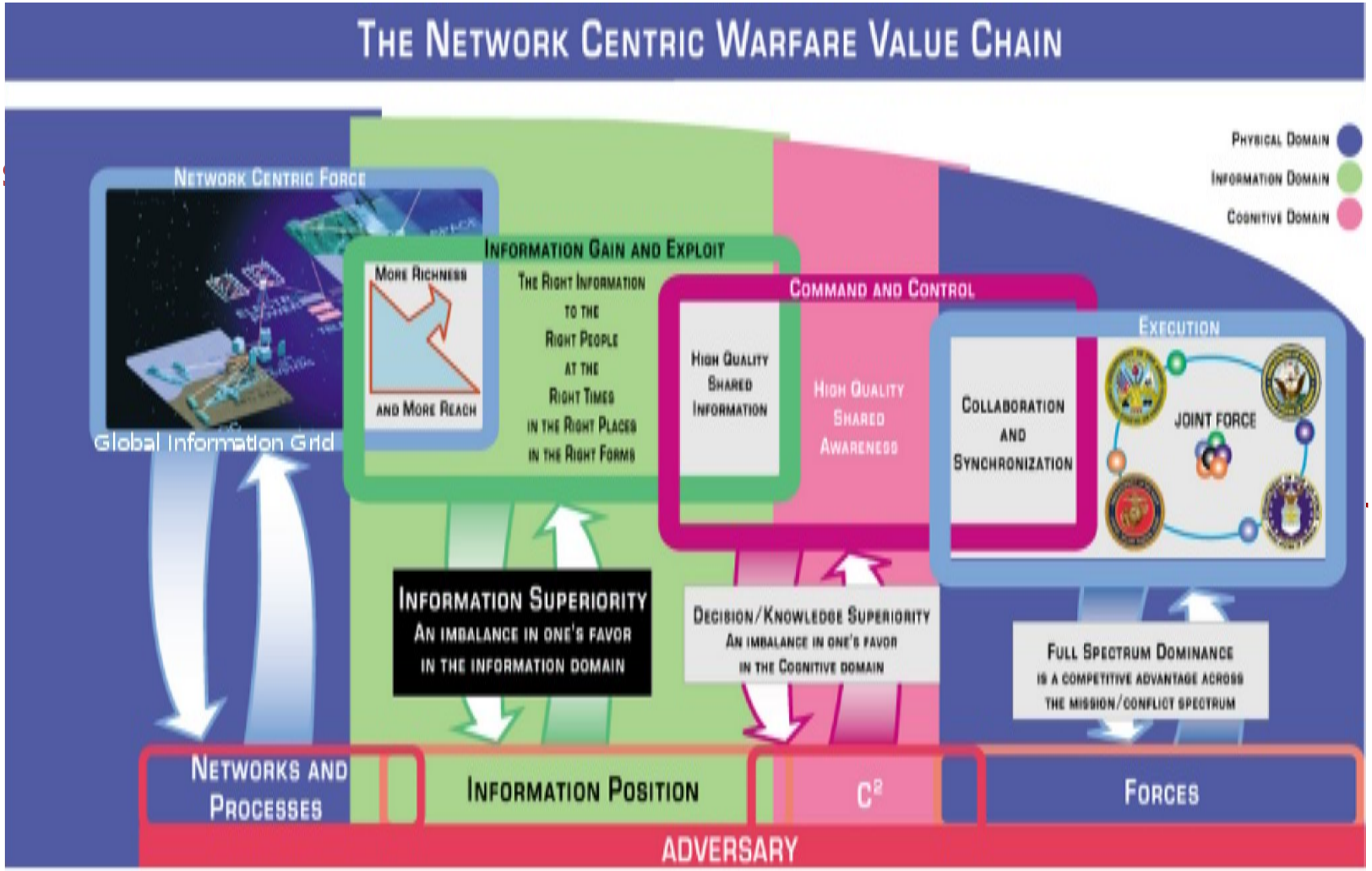
- Current Tops-down ConOps Development
- Network Centric Warfare
- Bottoms-up Performance Capability Assessment
- Research Considerations
- Performance Assessment
- Summary

Military ConOps Development and System Requirements Generalized Methodology Today:

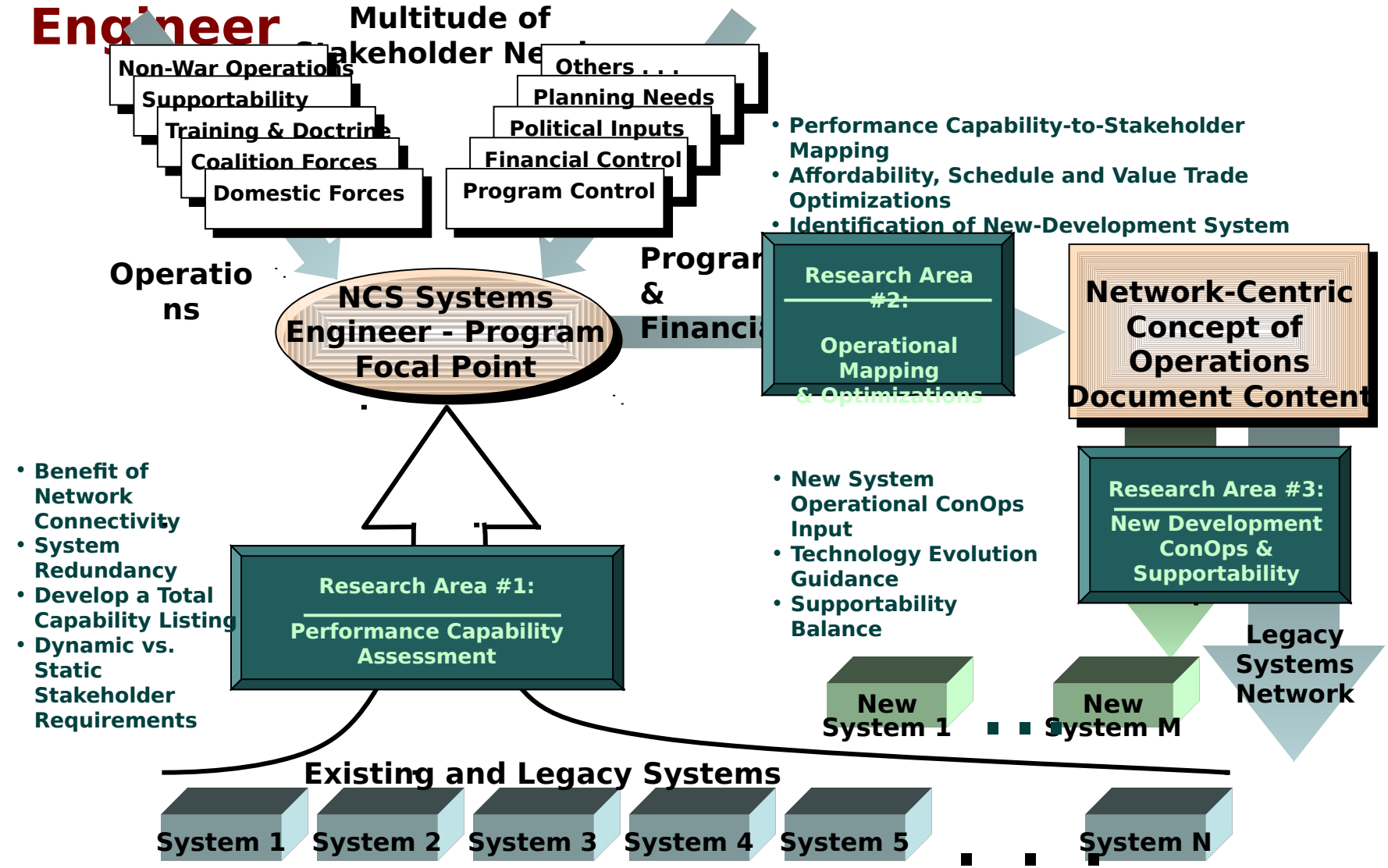


Network Centric Warfare

Source: Vision of NCW provided in a Department of Defense Report to Congress – September 2001 – http://www.c3i.osd.mil/NCW/



Research Opportunity in Support of NCS Systems Engineer



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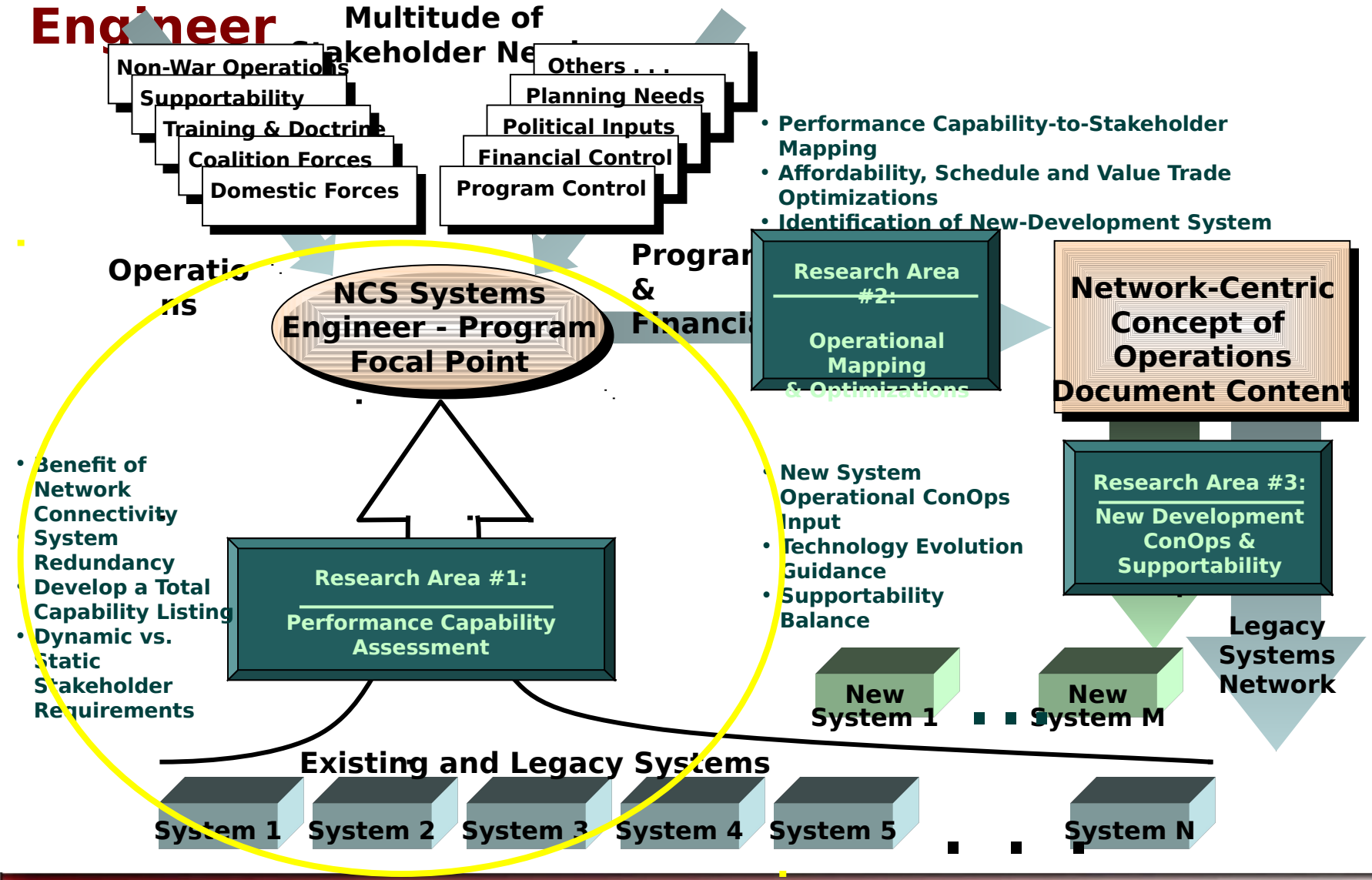


Total Performance of a Network-Centric System

$$P_{NCS} \approx \sum_{i=1}^{N} P_i + \sum_{i=1}^{N} \left(\sum_{k=1}^{M} \left(P_i \cap P_j \right)_k \right); \quad \text{For all } i \neq j \text{ AND } j = 1$$

where k > 0 (i.e. the system pairing has connectivity)

- P_{NCS} = The total performance of the Network-Centric System
- P_i = The performance capability of a Stand Alone System (no network connection)
- P_j = The performance capability of a Stand Alone System (no network connection)
- N = The number of Independent Systems (Network Nodes)
- M = The number of independent functional connection paths for a P_i and P_j pairing
- $P_i \cap P_j$ = This intersection represents the resultant performance from the system connectivity, which could be Zero if there is no system advantage or detractor, Positive if the connectivity advantages the ConOps (Mission Needs) or Negative if the connectivity is not required by the ConOps (i.e. outside of the mission performance boundaries)

NOTE: System Triples, Quadruples, etc. can also be considered as ne

Measuring the Performance of the NCS?

- **Individual System Contribution (as understood by it's own ConOps document)**
- **Networking of the systems results in potentially positive or negative Performance Benefit.**
- **The linkage of systems offers new direct functionality**
- **The linkage of systems offers an indirect functionality benefit (i.e., multiple path redundancy, degraded modes of operability)**
- **Negative linkage impacts such as Bandwidth overload, un-needed system-to-system connectivity leading lower system availability with no new performance benefit.**

Changing Program Needs Drives Varying NCS Solutions

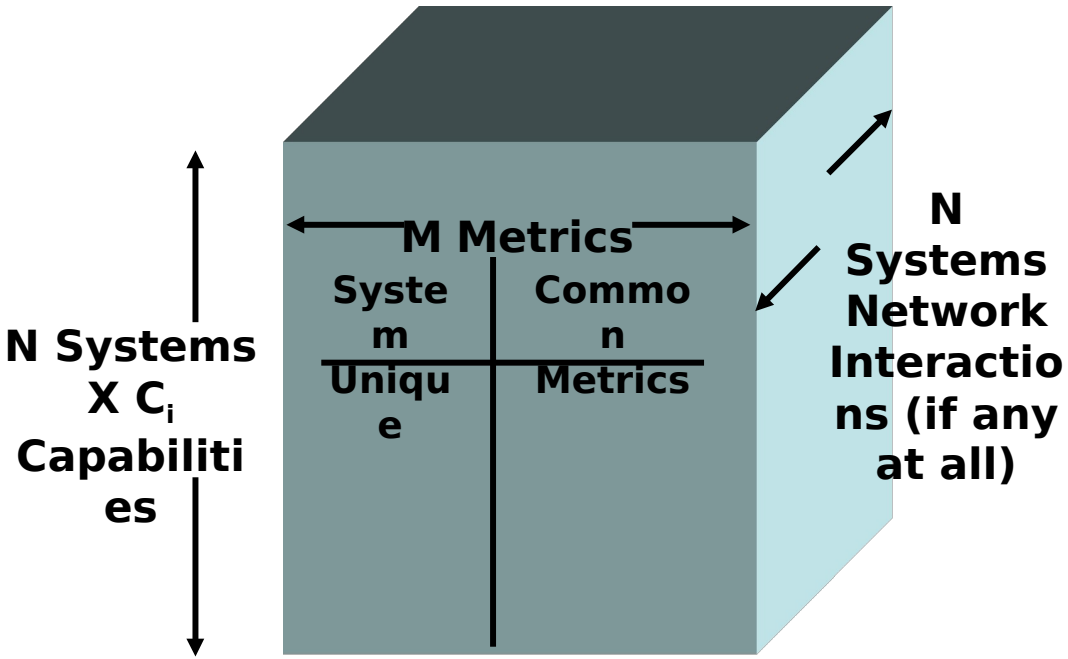
Direct Connectivity in NCS

- Intentional Connectivity
- Mission Performance requires linkage (Secure Wire, Microwave)
- Connect of System pairs yields summation of the separate functionality of the 2 systems PLUS New capabilities that the linkage allows
- Possible Redundancy or Conflicts due to identical input types yielding different results (i.e. meteorological reports) that will require arbitration
- Example: Connecting an Army Company information to a Theater Battle Command center. Direct Connectivity to provide better decisions.

Indirect Connectivity in NCS

- Unintentional Connectivity
- Result of WAN connections
- No Direct ConOps Requirement fulfilled by the connectivity
- Multi-path connectivity - Could be an advantage
- Example: Weather Radar Connectivity in a NCS. Valuable to those systems that use weather in decisions, and useless to all other LAN systems. Thus connectivity is available indirectly, but potentially not valuable.

General Metrics Structure for NCS Systems



Metrics Categories:

1. System Architecture
2. Data/Information & Networking
3. Supportability
4. Logistics
5. Technology Evolution
6. Cost Metrics

Axis Y = Capabilities per System, N.

Axis X = Metrics, M, for each capability (as appropriate)

Axis Z = Networking Advantages (or Disadvantages)

Conclusions

- NCS Complexity drives the need to provide the NCS Engineer (or team) with more insight for mapping out a NCS ConOps.
- Must Support NCS Engineer with:
  - Bottoms-up Performance Capability Assessment Method
  - Providing Mapping from Possible to Stakeholder Needs
  - Prioritizing of System Deployment
  - Optimizing Solution Recommendation
- Facilitate variable solution sets within ConOps Development
- Identify Gaps and Drive New System ConOps Development